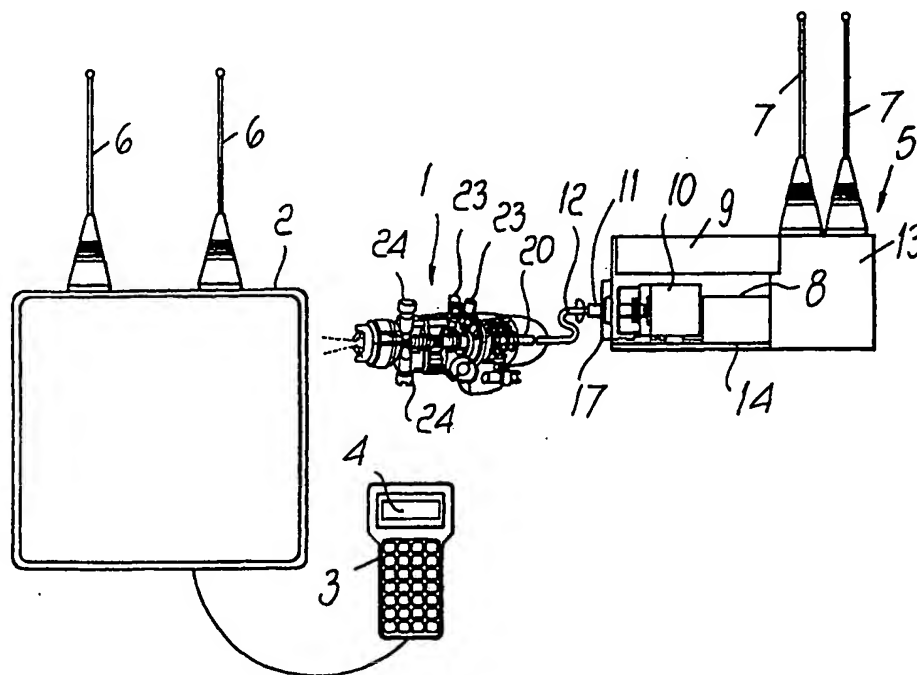


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<p>(21) International Application Number: PCT/EP99/05749</p> <p>(22) International Filing Date: 3 August 1999 (03.08.99)</p> <p>(30) Priority Data: MI98A001858 6 August 1998 (06.08.98) IT</p> <p>(71) Applicant (for all designated States except US): ABB FLEX- IBLE AUTOMATION S.P.A. [IT/IT]; Viale Edison, 50, I-20099 Sesto San Giovanni (IT).</p> <p>(72) Inventors; and (75) Inventors/Applicants (for US only): FERRARI, Giovanni [IT/IT]; Via Broggi, 7, I-28041 Arona (IT). VIOLA, Pierangelo [IT/IT]; Via G. Puccini, 32, I-10044 Pianezza (IT).</p> <p>(74) Agent: GIAVARINI, Francesco; ABB Ricerca S.p.A., Viale Edison, 50, I-20099 Sesto San Giovanni (IT).</p>	<p>(81) Designated States: BR, CN, JP, RU, US, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).</p> <p><b>Published</b> <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p>	

(54) Title: REMOTE CONTROL DEVICE FOR PAINT SUPPLYING GUNS



## (57) Abstract

A remote control device for paint supplying guns for painting systems, whose particularity is the fact that it comprises a main control unit which is suitable to communicate in a wireless manner with a plurality of remote control units (5), each associated with a respective paint supplying gun (1), said remote control units comprising control means and actuation means for regulating the flow-rate of the respective supplying gun and being remotely controlled by the main control unit (2).

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## REMOTE CONTROL DEVICE FOR PAINT SUPPLYING GUNS

DESCRIPTION

The present invention relates to a remote control device for paint supplying guns for painting systems.

5 The control device according to the present invention is particularly adapted for remotely controlling the activation of painting guns used for example in the field of hide painting and is now described with reference to this application without limiting in any way its scope of application.

It is known that in the field of hide painting a continuous rotary machine is  
10 currently used; said continuous rotary machine is constituted by a conveyor belt on which the hide to be painted is placed and by an overlying carrousel which supports a plurality of airbrushes, which are meant to dispense a preset amount of paint for painting the hides.

A hide finishing line can be provided with a plurality of automatic painting cells,  
15 each equipped with an airbrush rotating unit.

The above described apparatus, however, is affected by drawbacks due to the fact that owing to the delicate nature of the paint application process it is necessary to continuously adjust the paint flow-rate. Adjustment of the amount of paint dispensed by the individual airbrushes must be performed manually with a direct  
20 action of the operator on each airbrush, and this necessarily entails a process downtime (line stoppage) during which the operators perform the required adjustments.

The aim of the present invention is therefore to provide a remote control device for paint supplying guns for painting systems, in which it is possible to adjust the  
25 supplying of the painting product without necessarily interrupting the production cycle of the painting machine.

Within the scope of this aim, an object of the present invention is to provide a remote control device for paint supplying guns for painting systems, in which the dispensed flow-rate of the paint is adjustable for all the supplying guns

independently for each gun.

Another object of the present invention is to provide a remote control device for paint supplying guns for painting systems, in which adjustment is performed without requiring further actuation distribution.

- 5 Another object of the present invention is to provide a remote control device for paint supplying guns for painting systems, which can be used with any kind of currently commercially available gun.

Another object of the present invention is to provide a remote control device for paint supplying guns for painting systems, which is highly reliable, relatively easy  
10 to manufacture and at competitive costs.

This aim, these objects and others which will become apparent hereinafter are achieved by a remote control device for paint supplying guns for painting systems, characterized in that it comprises a main control unit which is suitable to communicate in a wireless manner with a plurality of remote control units, said  
15 remote control units being associated with a respective paint supplying gun and comprising control means and actuation means for regulating the flow-rate of the associated supplying gun, said remote control units being controlled by said main control unit.

Further characteristics and advantages of the invention will become apparent  
20 from the description of a preferred embodiment of the device according to the invention, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

figure 1 is an overall schematic view of the control device according to the invention, applied by way of example to a paint supplying gun;

- 25 -figure 1a is a plan view of a remote unit according to the present invention;

-figure 2 is a sectional schematic view of the detail of the flow-rate regulation of a paint supplying gun;

-figure 3 is a general block diagram of the control device according to the present invention;

-figure 4 is a block diagram of the main unit of the control device according to the present invention;

-figure 5 is a block diagram of a remote unit of the device according to the present invention.

5 With reference to the above figures, the remote control device according to the present invention, applied to a paint supplying gun or airbrush 1, comprises a main control unit 2 provided with data input means 3, conveniently provided by means of a handheld keypad provided with a display 4, and a plurality of remote units 5, one for each one of the airbrushes 1 used in the painting apparatus.

10 The remote unit 5 communicates in a wireless manner with the main control unit 2 by means of the antennas 6 and 7, which are arranged respectively on the main control unit 2 and on each one of the remote units 5. As shown in figure 1, the main control unit 2 and each remote unit 5 are provided with two antennas 6 and 7, respectively; alternatively, if necessary, it is possible to use only one antenna (6  
15 or 7) or more than two.

In detail, each remote unit 5 comprises, in addition to the antennas 7, a transceiver module 8 which is meant to be connected to the antennas 7, an actuation device or driver 9 for a motor 10 whose shaft 11 is connected to a paint supplying gun 1, through connecting means which are advantageously provided by means of a  
20 flexible cable 12.

Each remote unit 5 is furthermore provided with its own power supply means, conveniently provided for example by batteries 13; alternatively, said power supply means can comprise a turbine or other means provided they are compatible with the application. A microprocessor control card 14 allows to control a  
25 microprocessor contained in the main control unit 2.

Figure 1a is a plan view of the remote unit 5, illustrating a device for detecting the rotation of the motor 10, designated by the reference numeral 16, and conveniently provided for example by an encoder, which is meant to detect in each time the position of the shaft 11 of the motor and accordingly of the element

actuated by said shaft, which is described hereinafter.

The reference numeral 17 instead designates a sealing flange of the shaft 11 of the motor 10.

The remote unit 5, arranged directly on the supplying gun or airbrush 1 and consequently the remote-controlled motor 10, are controlled by means of multiple-frequency radio pulses by the main control unit 2, so as to act, by means of the flexible cable 12, on actuation means for regulating the flow-rate of the paint supplying gun 1.

With reference now to figure 2, the means for adjusting the flow-rate of the airbrush 1 are illustrated in detail.

In particular, the reference numeral 20 designates an adjustment screw against which a piston 21 acts by abutment; the stem of the piston 21 is constituted, at the opposite end with respect to the adjustment screw 20, by a pin or needle 22 for adjusting the flow-rate of the paint. Said needle 22 can be made to perform a translatory motion, by means of the piston 21, from a fully closed paint supplying position to a fully open position in which the flow-rate is accordingly maximum.

This flow-rate adjustment, by means of the needle 22, occurs by moving the piston 21 into abutment against the adjustment screw 20, which accordingly is meant to determine the useful stroke of the piston 21.

The position of the screw 20 is therefore determined by the motor 10 by means of the shaft 11 and the flexible cable 12.

The piston 21 is actuated pneumatically by air injected into a duct 23, whilst the duct 24 illustrated in figure 1 is the paint inlet point.

Figure 1 illustrates two ducts 23 and two ducts 24.

The two ducts 24 are meant to allow the connection in series of multiple airbrushes 1 if required.

Figures 4 and 5 respectively illustrate in detail, as a block diagram, the structure of the main control unit 2 and of each remote unit 5.

The main control unit 2 comprises the local terminal, provided by the handheld

keypad 3, for setting and displaying position values of each remote unit 5, which is interfaced with the outside by virtue of the interface means 4. The local terminal 3 is connected to data processing means 26 which are conveniently provided by a microprocessor provided with a log of the positions of the remote units 5 which is always up-to-date to one preceding step. The memory of the microprocessor stores a multitasking program for the management of the various remote units 5. The microprocessor 26 communicates with a battery charger 27 which is provided with an analog control of the value of the voltage and current for recharging the remote unit 5.

The microprocessor is bidirectionally connected to a data preparation module 28, which is meant to store all the data to be transferred to the remote units 5 to be remotely controlled, in order to send them to multiplexing means 29 and to data synchronization means 30.

The multiplexing means have time-dependent control over access to the remote units 5, so as to correctly select the remote unit 5 that has to be driven, and send signals to encoding means 31 of the transmission protocol, which are connected to the transmission means 32 which are in turn connected to solid-state switching means 33 with an antenna 6.

The solid-state switching means 33 are also meant to receive, by means of the antenna, reply signals from the remote units 5; said signals are sent to receiver means 35, decoded by decoder means 34, and sent to the multiplexing means 29 and then to the data synchronization means 30, which check the synchronization between the data sent by the microprocessor 26 and the data received by the remote units 5.

Figure 5 illustrates in detail, as a block diagram, the structure of each one of the remote units 5.

Said remote units comprise selection means 40 which allow to code the remote unit so that the microprocessor can drive each remote unit 5. A processing unit 41, which comprises a microprocessor, is connected to the selection means 40 and

comprises and a memory which contains values which need to be changed but in any case must not be lost when the control device is switched off. Power supply means 42 are connected to the processing unit 41 and are provided with a device for electrical insulation with respect to the connector of a battery charger and with  
5 a battery control device with real-time analysis of the remaining power.

The motor 10, which transmits the rotation to the adjustment screw 20 for opening the needle 22 of the airbrush 1, receives the signals from the processing unit 41; the driver 9 drives the motor 10, and the detection of the rotation of the shaft 11 of the motor 10 and therefore of the opening stroke of the needle 22 of  
10 the gun 1 is performed by means of the encoder 16, which is directly connected to the shaft 11 of the motor. The pulses read by the encoder 16 are transmitted to the processing unit 41.

The processing unit 41 sends data to the encoder means 43 of the remote unit 5 and then the data are passed to the transmission means 44 and by means of solid-state switching means 45 with an antenna 7 the data are transmitted to the main  
15 control unit 2 and received by it by means of the antenna 6.

The switching means 45 furthermore receive, by means of the antenna 7, the data from the main control unit 2 and, by means of receiver means 46 and decoder means 47, said data are forwarded to the processing unit 41 of the remote unit 5.

20 The motor 10 that is used can be of various kinds, for example a step motor, a DC-powered permanent-magnet motor, or a brushless motor complete with an encoder and a resolver, or a servomotor.

In practice it has been found that the control device according to the invention fully achieves the intended aim and objects, since it allows to radio control the  
25 opening of the needle for regulating the paint supplying flow-rate of each painting unit by means of a motor which acts directly on the adjustment screw that actuates said needle.

In this manner it is possible to provide remote control without interrupting the operating cycle of the painting machine, furthermore being able to independently



adjust each airbrush according to the requirements.

The device thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the inventive concept; all the details may furthermore be replaced with other technically equivalent elements.

- 5 In practice, the materials used, so long as they are compatible with the specific use, as well as the dimensions, may be any according to the requirements and the state of the art.

CLAIMS

1. A remote control device for paint supplying guns for painting systems, characterized in that it comprises a main control unit which is suitable to communicate in a wireless manner with a plurality of remote control units, said remote control units being associated with a respective paint supplying gun and comprising control means and actuation means for regulating the flow-rate of the associated supplying gun, said remote control units being controlled by said main control unit.
2. A remote control device according to claim 1, characterized in that the main control unit and the remote control units mutually communicate by means of multiple-frequency radio pulses.
3. A remote control device according to claim 1, characterized in that said actuation means comprise at least one motor whose shaft is connected, through connecting means, to a screw for regulating the flow-rate of a supplying gun.
4. A remote control device according to claim 3, characterized in that said motor comprises a step motor, or a DC-powered permanent-magnet motor, or a brushless motor, or a servomotor.
5. A remote control device according to claim 3, characterized in that said connection means comprise a flexible cable.
6. A remote control device according to one or more of the preceding claims, characterized in that said remote units comprise power supply means, electronic control means, means for determining the position of the motor shaft and transceiver means.
7. A remote control device according to claim 6, characterized in that said transceiver means comprise at least a first transceiver antenna suitable to exchange data with the main control unit.
8. A remote control device according to claim 6, characterized in that said means for determining the position of the motor shaft comprise an encoder.
9. A remote control device according to claim 6, characterized in that said

electronic control means comprise a processing unit which is operatively connected, by means of encoder and decoder means, to transmitter and receiver means, said transmitter and receiver means being in turn connected to said first transceiver antenna by means of switching means.

5 10.A remote control device according to claim 7, characterized in that said processing unit comprises a microprocessor.

11. A remote control device according to one or more of the preceding claims, characterized in that said main control unit comprises data entry and display means.

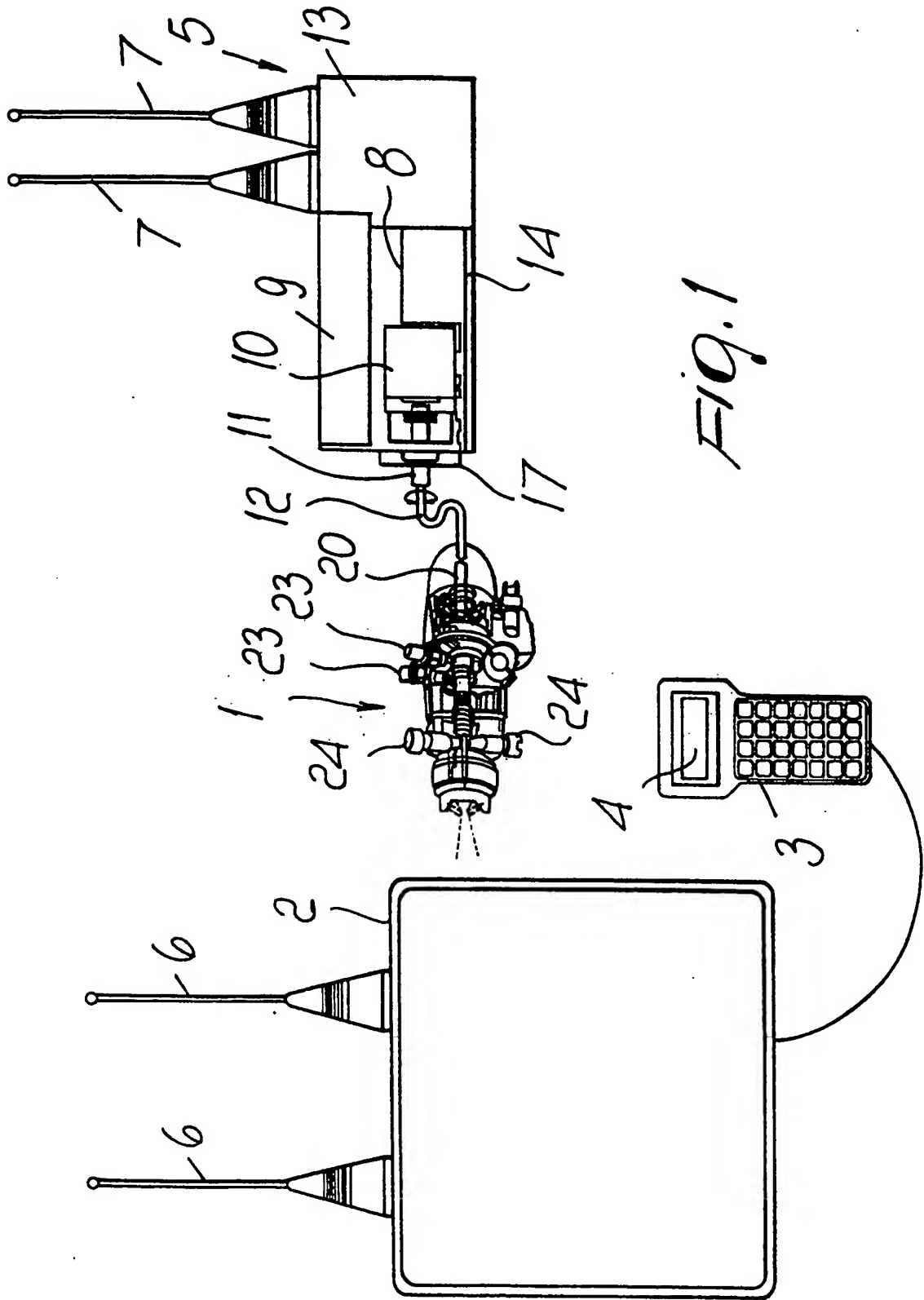
10 12.A remote control device according to one or more of the preceding claims, characterized in that said main control unit comprises at least a second transceiver antenna suitable to exchange data with the first receiver antenna.

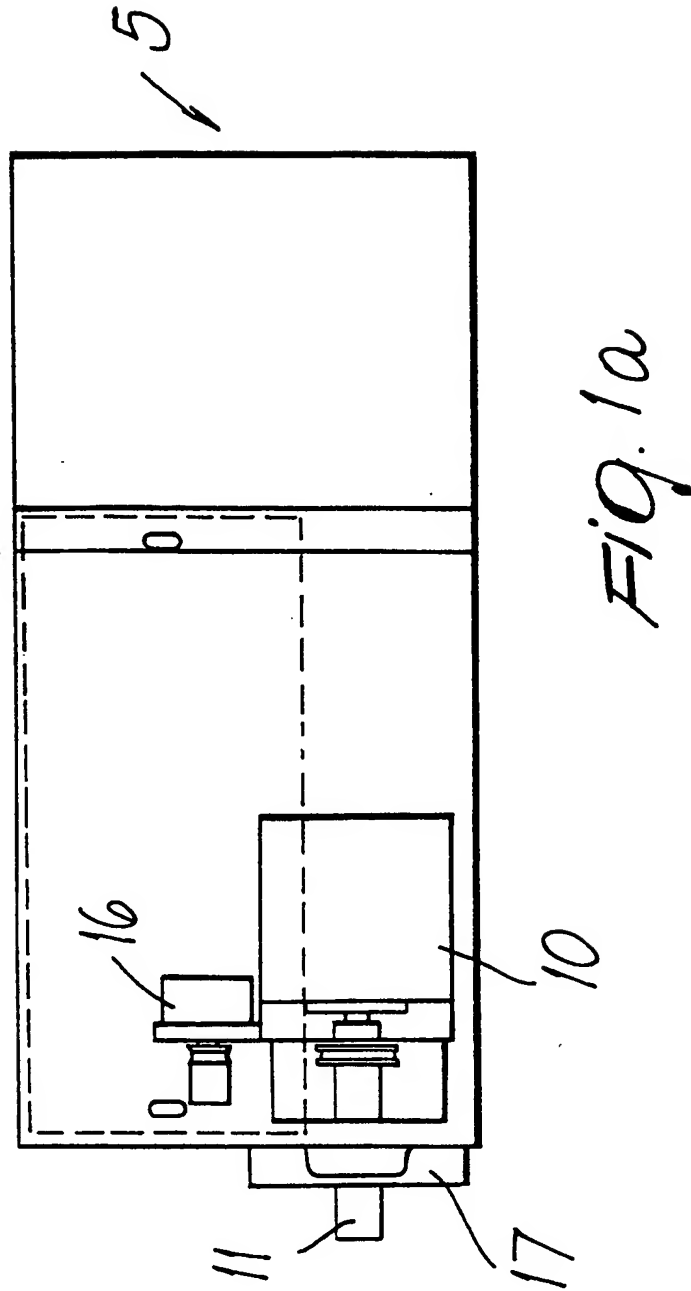
13. A remote control device according to claim 12 characterized in that said main control unit comprises data processing means which are operatively connected  
15 to multiplexing means suitable to select the remote unit to be driven, said multiplexing means being connected to encoding means and to transmission means which are in turn operatively connected to switching means and to said second transceiver antenna.

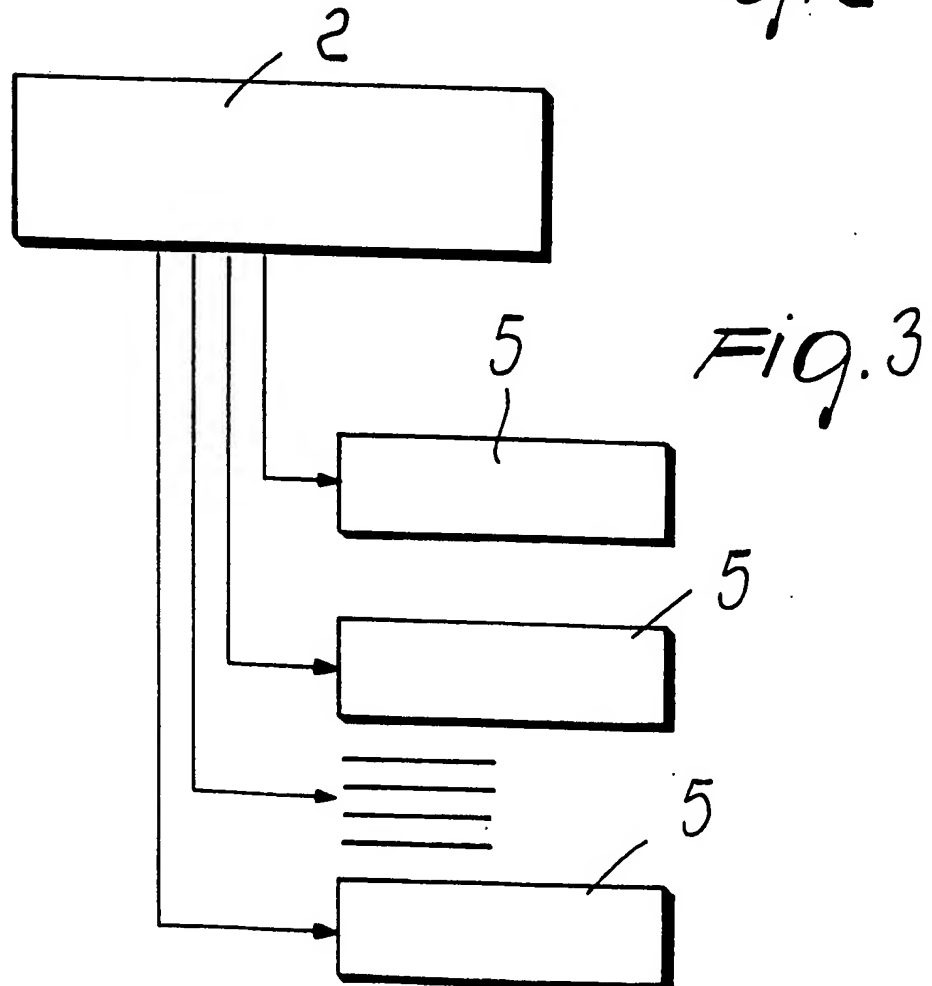
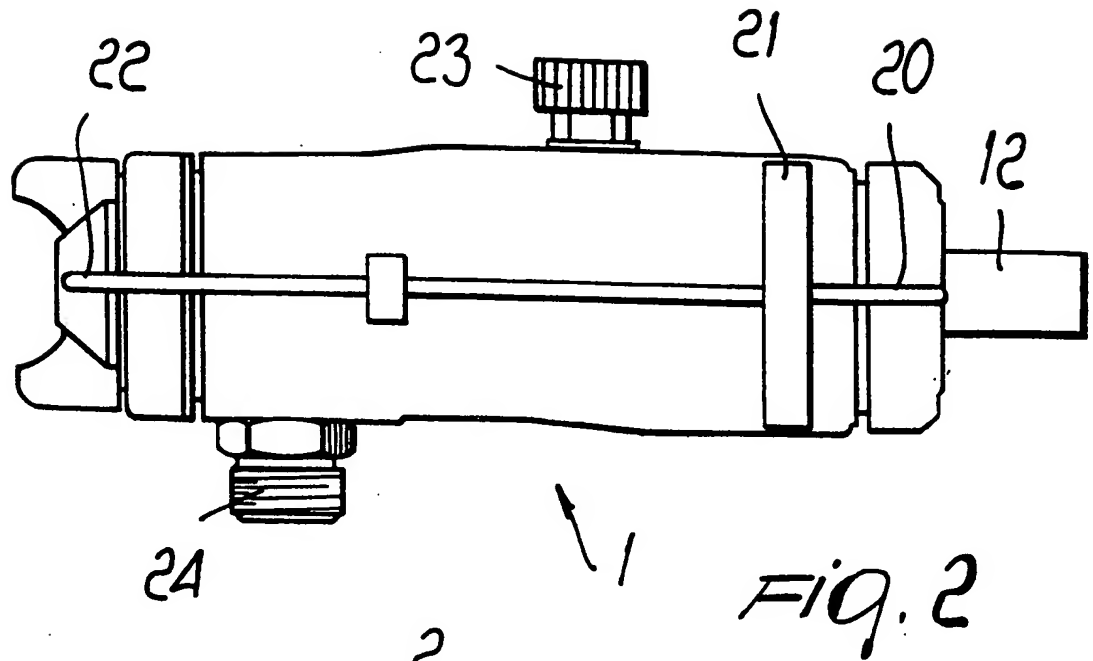
14.A remote control device according to claim 13, characterized in that said  
20 multiplexing means receive in input signals from each one of said remote units said signals being received by means of said second transceiver antenna and being transmitted to the multiplexing means by virtue of receiver means and decoder means.

15.A remote control device according to one or more of the claims 11 to 14,  
25 characterized in that said main control unit comprises data synchronization means which are suitable to provide synchronization between the data sent to and received from each one of said remote units.

16.A remote control device according to claim 13, characterized in that said data processing means comprise a microprocessor.







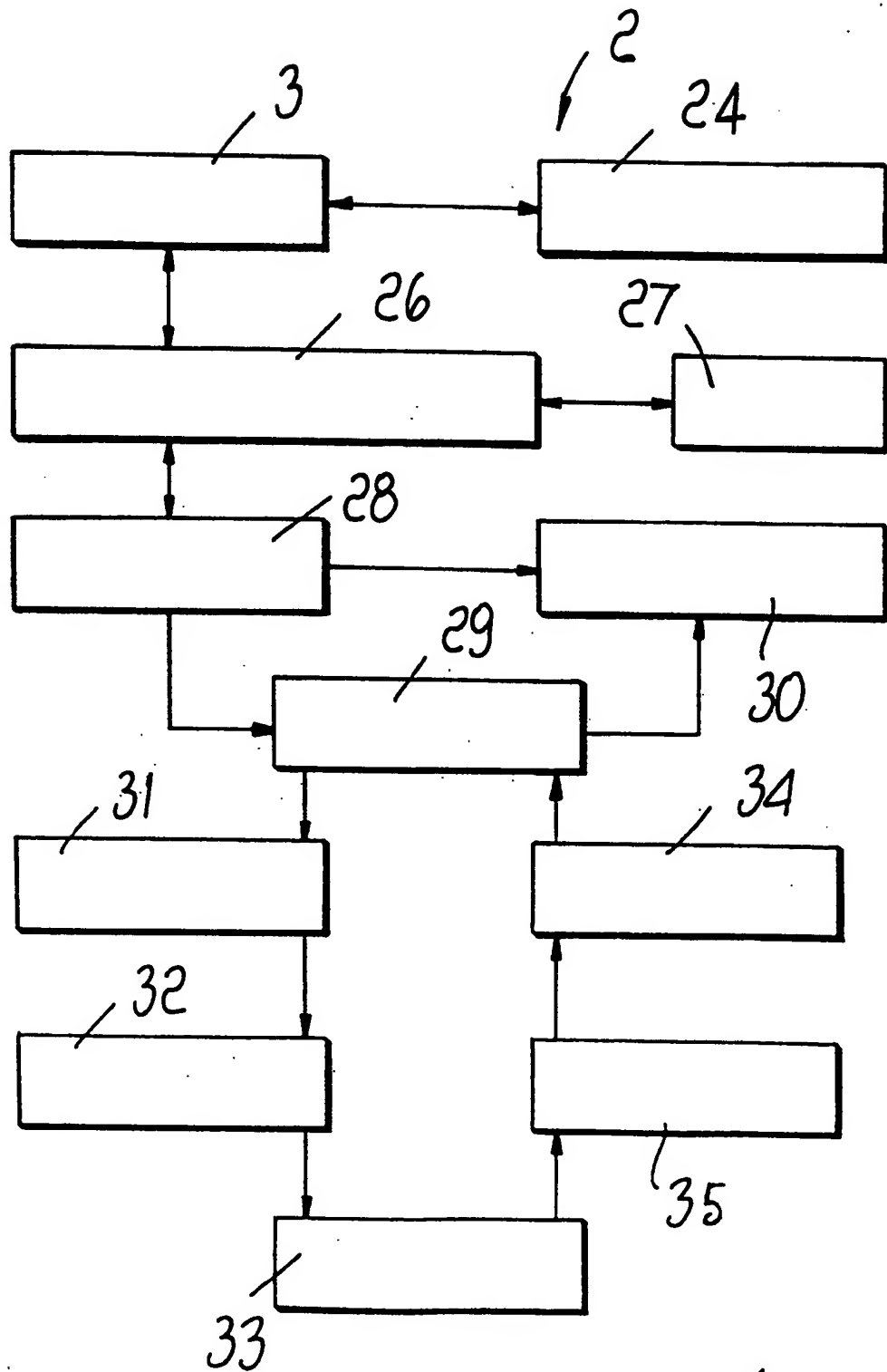


FIG. 4

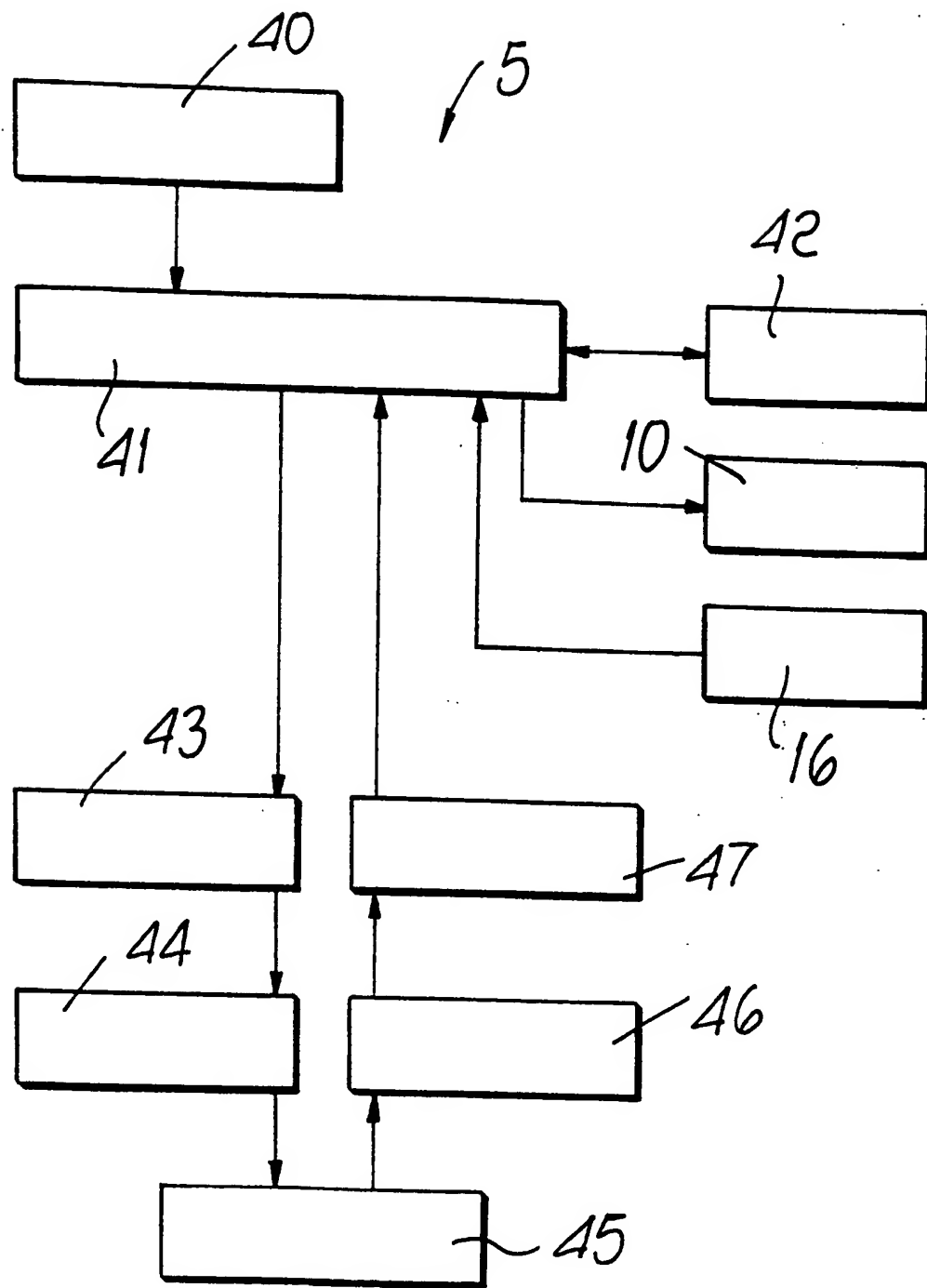


Fig. 5



# INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 99/05749

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B05B12/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 381 962 A (TEAGUE) 17 January 1995 (1995-01-17) column 1, line 21 - line 22 column 7, line 20 - column 9, line 57	1,2,11, 12
A	column 4, line 24 - column 6, line 1; figure 1	3,6,13, 15
X	US 4 722 625 A (O'BRIEN) 2 February 1988 (1988-02-02) abstract column 3, paragraph 2 column 3, line 47 - line 54; figure 1	1,2,11, 12
X	US 5 660 334 A (TRUSTY ET AL.) 26 August 1997 (1997-08-26) column 1, line 64 - column 2, line 4 column 4, line 49 - line 67 column 5, line 23 - line 30	1,2,11, 12

-/--



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

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Date of the actual completion of the international search

16 December 1999

Date of mailing of the international search report

11/01/2000

Name and mailing address of the ISA

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# INTERNATIONAL SEARCH REPORT

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## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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# INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No

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PCT/US2005/003352

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B05B12/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B05B A01B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

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## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2 832 134 A (VALOIS SA) 16 May 2003 (2003-05-16)	1,4-8, 10,11, 13,15
Y	page 3, line 6 - page 4, line 30; figures 1,5	2,3,9, 14,16-20
Y	----- EP 1 084 757 A (NORDSON CORPORATION) 21 March 2001 (2001-03-21) paragraphs [0040] - [0048], [0051]; figures 1-3,5-7	2,3,14, 17-20
Y	----- US 6 500 262 B1 (BEDNARZ VINCENT L ET AL) 31 December 2002 (2002-12-31) paragraph [0027]; figures 1,6b ----- -/--	9,16

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Date of the actual completion of the international search

26 May 2005

Date of mailing of the international search report

18/10/05

Name and mailing address of the ISA

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Endrizzi, S

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 00/07741 A (ABB FLEXIBLE AUTOMATION S.P.A; FERRARI, GIOVANNI; VIOLA, PIERANGELO) 17 February 2000 (2000-02-17) page 1, line 25 - page 2, line 18 page 3, lines 5-15 page 4, lines 22,23 page 5, lines 14-29 page 6, lines 28,29 figures 1,3-5	1,2,4,5, 9-11,13, 15-18,20
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# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US2005/003352

## Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2. ☐ Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
  
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
  
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
  
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
  
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1 - 20

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

## FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-20

Documents FR-2832134 and WO-00/07741 disclose all the features of claims 1-11 (see Item V), therefore the first technical feature not known from the prior art is claim 12. Hence it is considered that claims 1-20 are directed to a material application system and a method comprising a wireless identification device which is associated with a spray gun nozzle. It is considered that the wireless identification device associated with a spray gun nozzle comprises a first "special technical feature".

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2. claims: 21-23

Claims 21-3 are directed to a method for identifying parts of an item; each part of the item has a wireless identification device. It is considered that the wireless identification devices associated with each of the parts of the item comprises a second "special technical feature".

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3. claim: 24

Claim 24 is directed to a method for identifying parts of an material application system in which at least the spray booth has a wireless identification device. It is considered that the wireless identification device associated with spray booth a third "special technical feature".

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INTERNATIONAL SEARCH REPORT  
Information on patent family members

International Application No  
PCT/US2005/003352

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
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